THE MELTON HILL PROJECT

A REPORT ON THE PLANNING, DESIGN, CONSTRUCTION, INITIAL OPERATIONS, AND COSTS

TECHNICAL REPORT No. 15

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KNOXVILLE, TENNESSEE

FIGURE 141.—*Trees were generally cut with stumps no higher than 4 in. Low cutting removed navigation hazards and permits machine mowing for plant growth control.*

required that the stumps be cut to ground level. Hazards, such as building foundations, chimneys, abandoned bridge piers, and hazardous rock outcroppings, were reduced to near ground level either by the clearing crews during normal cleanup work or by blasting.

During reservoir filling the pool was held at channel bottom El. 779 while a thorough inspection was made by boat of the channel to see that no obstructions remained. A few snags and fenceposts were removed.

Dredging

In the initial planning for Melton Hill Reservoir, TVA worked with the local port authorities and planning commissions to assure that the waterfront industrial lands along the reservoir would be preserved for industry. The local people recognized this need and zoned the prime waterfront areas for industrial use. Dredging was necessary to provide navigation to the farthest upstream area. The usual requirement of 11-ft channel depth below extreme drawdown El. 790 was reduced to 10 ft in this upstream section because of two factors: (1) the likelihood that the streamflow from Norris Dam, 19 miles upstream, would increase the minimum depth to 11 ft nearly 100 percent of the time and (2) the increased cost of dredging an additional foot. The flow of the Clinch River was cut off at Norris Dam so that dredging could be done with dry-land equipment (fig. 142), and the job was completed in a minimum of time. It was estimated that regulating the streamflow reduced the cost of dredging about $229,000.

An additional 1-mile section upstream from the end of the 10-ft channel was cleared to El. 784. The limited channel will permit commercial barges loaded

FIGURE 142.—*By virtually stopping the flow of the Clinch River at Norris Dam, 19 miles upstream, it was possible to excavate to channel bottom grade with dry-land equipment.*

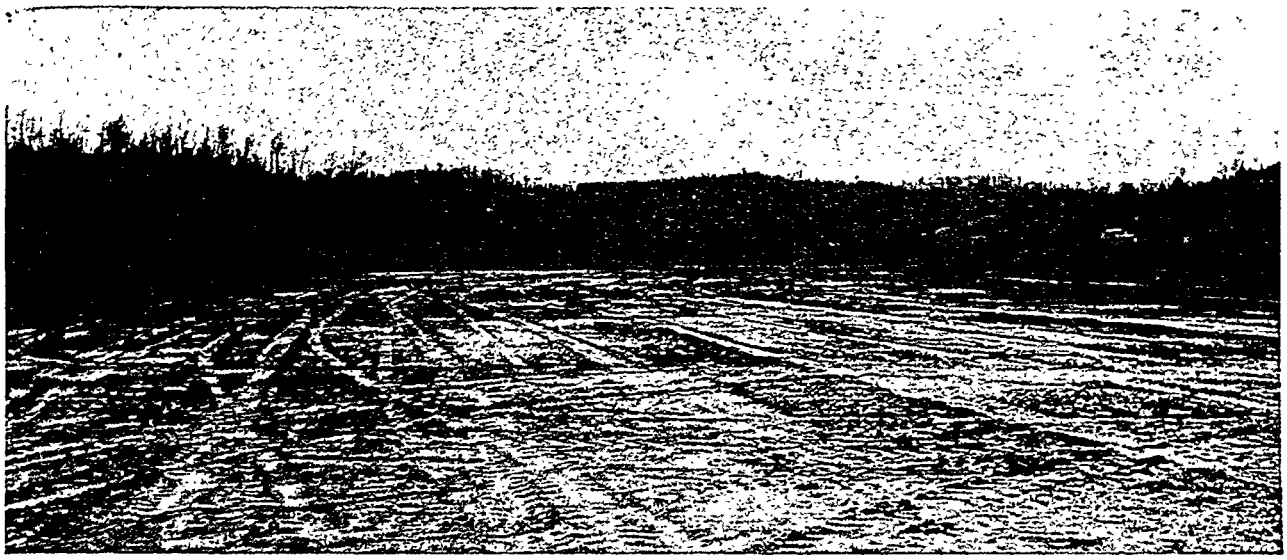

FIGURE 143.—*At several points grading along the old riverbanks removed high berms and other hazards and improved the alignment of the sailing line.*

to 6-ft depth to serve upstream sites in the Eagle Bend area.

Dredging was also required in Watts Bar Reservoir, at Grubb Island, Jones Island, and immediately downstream from Melton Hill lock, to extend the 11-ft channel depth on the Clinch River to the new lock. Dredging in the reservoir and below the dam is discussed later in this chapter.

Navigation facility projects

In the vicinity of Cruickshank Bend, Clinch River mile 37, the navigation channel, if it followed the old river, would be restricted by a series of reverse curves. To improve the sailing line, three overbank grading projects were undertaken; two small projects downstream from the bend (fig. 143) and a larger project adjacent to the left bank formed a new cutoff channel across the bend. All of the grading projects were completed before the reservoir was filled. The spoil material from the new channel was placed in a large mound along the right side of the channel in the middle of the bend. The mound extends several feet above the water surface and is an aid in defining the limits of the channel (fig. 144).

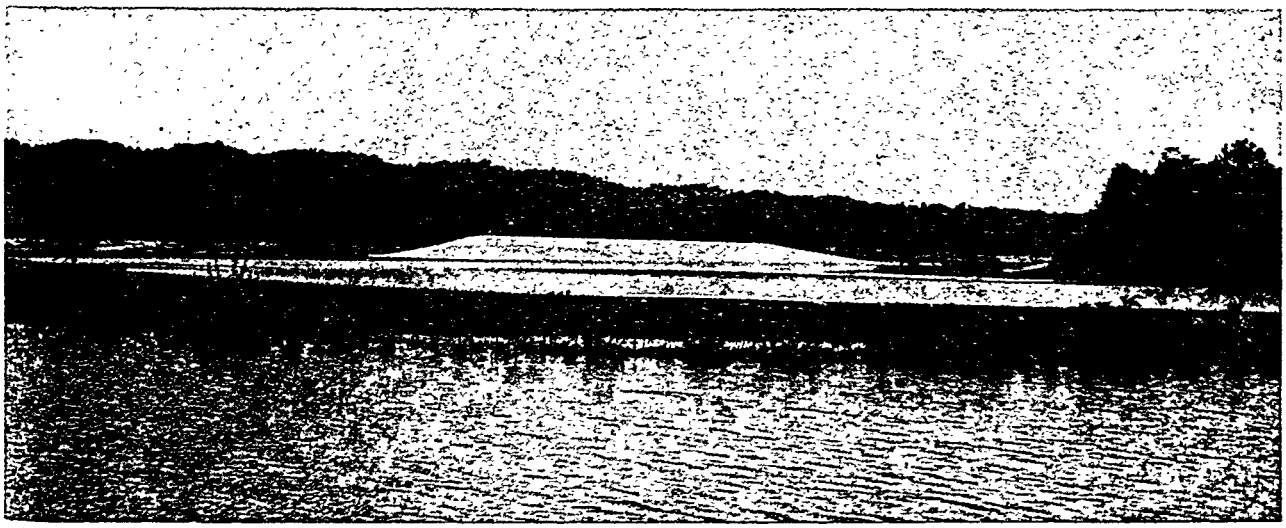

FIGURE 144.—*The sailing line was improved at Cruickshank Bend by grading a new channel across the neck of the bend. The spoil material was placed in a large mound several feet above normal pool and is used as a channel marker.*

FIGURE 145.—*Safety landings are usually established at about 5-mile intervals where practicable. At mile 46.6 one was prepared along the ash disposal dike at the Bull Run Steam Plant.*

Two small islands were graded to channel bottom at mile 53.4, rock outcroppings were removed from the safety landing at mile 50.6, and extensive grading was required in a safety landing at mile 46.6 (fig. 145). Concrete mooring posts, cables, and mooring rings were installed in the safety landings at miles 46.6 and 50.6 (fig. 146).

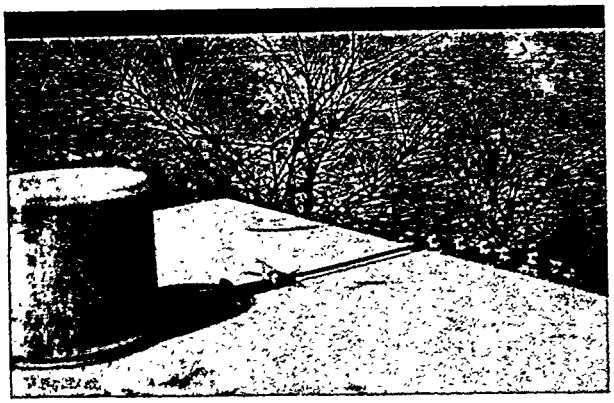

FIGURE 146.—*In two safety landings where there were no trees along the shoreline for tieup of tows, concrete mooring posts were constructed. Steel rings, fastened to a cable from the post, serve as tieup points at various pool levels.*

Secondary channels

Tributary streams having a minimum water depth of 4 ft below extreme drawdown were considered navigable for large recreational boats. Preparation of these secondary channels consisted mainly of removing high stumps and rock outcroppings and marking the channels with navigation aids. Because of the small fluctuation between full and minimum pools it was thought feasible to use a new type of secondary channel marker. These markers are 12- by 24-in. sheets of aluminum, with one end forming a pointer. They are attached to 3-in. galvanized pipe so that the arrow points toward the channel (fig. 147). Two-inch strips of reflective tape (Scotchlite) outline the markers so that they can also be located at night. The markers were installed by TVA construction forces prior to filling the reservoir. Replacements can be driven in place from a work barge. Twenty-nine of the markers were installed to mark 6.3 miles of secondary channels.

Eight commercial recreational boat docks have been built along the reservoir, and several of these were finished prior to completion of the dam (fig. 148). An extensive amount of grading and harbor work was done prior to reservoir filling by the Cities of Oak Ridge and Clinton (fig. 149). Several public boat launching ramps were built by Anderson and Knox Counties during the construction period.

Navigation Branch all trees above El. 779 and below 796 were cut 4 in. or less above ground level to clear the channels of navigation hazards. Another reason for low stumping was to permit machine mowing between the 790 and 796 contours for plant growth control. Low stumping was a very difficult task, particularly along the steep riverbanks where it became necessary to uproot many of the larger stumps and burn them. This contributed to the high overall clearing cost. All nonsalvageable timber, logs, brush tops, rooted out stumps, and other material which might float or collect flotage were piled and burned or otherwise disposed of.

Clearing operations in the reservoir began near the dam site on March 20, 1961, and were essentially completed in May 1963. The clearing, wherever possible, was carried out by use of clearing blades mounted on crawler tractors. This method of clearing made it possible to fell the trees and underbrush and pile for burning in one continuous operation with a minimum of trimming or hand work. Bank clearing proved to be another difficult and expensive task. The large trees and heavy undergrowth overhanging the water along the naturally steep riverbanks had to fall in the water. Then they had to be dragged to the top of the riverbanks with tractors and winches and prepared for burning (fig. 151). Bank clearing, as well as that not suited for equipment clearing, was accomplished by use of portable, gasoline-driven power saws and hand tools.

Marginal drainage provided that all depressions lying between the 790 and 796 contours, which would become filled at maximum water level and hold water to form isolated pools when the water level was lowered, should be connected with the main body of the reservoir by the installation of suitable drains.

FIGURE 151.—*Riverbank clearing often required that large trees be allowed to fall into the water. They were later towed up the riverbanks and piled for burning.*

These specific areas were designated and the work was coordinated by the Vector Control Branch, Health and Safety Division. There were six such areas that required attention. Ditches to provide suitable drainage were dug with dozers and patrol graders, and excavated spoil was blended into the surrounding terrain.

Highway and railroad adjustments

The major portion of highway and railroad adjustment work was carried out during the period from May 1961 to September 1963. This involved movement of approximately 576,000 cu yd of unclassified excavation and borrow material, most of which was handled by bulldozers and rubber-tired scrapers. Rockfill revetment and riprapping required some 180,600 tons of rock, and 81,235 tons of crushed stone was used in this and other aspects of the work. All rock, quarry run and crushed, was purchased under contracts and was delivered by vendors' trucks to points of placement. TVA contracted the paving of two Oak Ridge highways requiring 5500 tons of binder for the 3-in. base course and 2250 tons of asphaltic concrete for the 1¼-in.-thick surface course. Bituminous surface treatment by C&M forces amounted to approximately 8900 sq yd. Construction of a bridge and minor drainage structures required 1550 cu yd of transit-mixed concrete and 164 tons of reinforcing steel. Approximately 7500 lin ft of steel beam guardrail and 2000 pressure-treated wood guardposts were installed. Post holes were dug with a hole-digging attachment mounted on a small farm-type tractor.

Navigation improvements in the reservoir

To carry out the navigation improvement plan, work in the reservoir was begun on August 4, 1962, and completed May 10, 1963. The channel work was scheduled so it would be completed prior to filling the reservoir and therefore permit maximum use of conventional dry-land excavating equipment. These operations involved the removal of 95,540 cu yd of earth and 25,015 cu yd of rock from the riverbed in a 3.2-mile stretch in the Clinton and Alton Island areas, 99,900 cu yd of material from main channel overbank, and 12,000 cu yd of material from main channel safety landings. Total dry excavation for navigation improvement in the reservoir amounted to 220,500 cu yd, which was accomplished at a cost of $0.84 per cu yd.

The major work developed in the Clinton and Alton Island areas. This work had to be scheduled during favorable weather and coordinated with water releases at Norris Dam and periods of low local runoff. This necessitated multiple-shift operations and overtime in some cases to conclude the work by the reservoir filling date. In the Clinton Island area

the rock encountered above project depth varied in thickness from less than a foot to 6 ft and covered an area of approximately 225,000 sq ft. Drilling and blasting operations required some 8360 holes and 24,850 lb of dynamite. Work in this area involved as many as eight bulldozers, three tractor-drawn scrapers, a rooter, and a dragline.

Most of the loose and broken rock was spoiled along the riverbanks to form an approximate slope of 2½:1 or was used to build up Clinton Island. Finer material was also used as island fill or deposited in the channel below designed depth. Some was also used to form dikes to divert river flow and thus lower the water level in the work areas.

Navigation improvements downstream

Channel dredging downstream from the dam was necessary to obtain the specified 11-ft minimum depth (below Watts Bar Reservoir drawdown El. 735.0) and the desired width. Due to the narrow valleys and high bluffs, the channel as built actually varies in width from 155 to 265 ft. Channel work started at Clinch River mile 18.2, and approximately 3.2 miles of the 4.8 miles to the lock was affected. Dredging was started in September 1962; but due to a greater need for personnel and equipment at main river installations and in the reservoir, the work was carried out intermittently and was not completed until late 1965. During this period over 351,600 cu yd of material was removed from the channel above El. 723.0 (1 ft below design depth El. 724.0) at a cost of $4.50 per cu yd. Despite efforts to excavate no more than 1 ft below design depth, removal of obstructions near El. 724.0 resulted in over-excavation. According to final cross sections, about 104,000 cu yd of material was removed below El. 723.0 which could not be considered in calculating the unit cost of removal. Other factors adversely affecting the unit cost include (1) interruptions of the work to use equipment and personnel elsewhere, (2) strong river currents which entangled the blasting lines and caused malfunctions, (3) water level fluctuation from rainfall and uncontrolled flow which not only affected the actual dredging but made difficult the checking of the channel depth, (4) equipment repair including modifications to suit the work, and (5) difficulty in developing satisfactory drilling and blasting patterns and procedures.

The major equipment used in the dredging operations was a 12-in. suction dredge, a Manitowoc 3-cu-yd dipper dredge (also used with drag bucket), a steam-operated American Revolver crane with sweeping and clamshell attachments, a drill barge, an underwater dozer, a check-sweep barge, and towboats.

Drilling and blasting — An available 110-ft-long barge was job equipped and used for the drill barge. Four drill bars, each carrying a Gardner-Denver DH99 percussion drill, were installed along one side of the barge, and a work platform extended along the same side near the water level (fig. 152). Air was supplied by two 600-cfm portable air compressors. An area about 100 ft wide was normally drilled and loaded for each channel crossing.

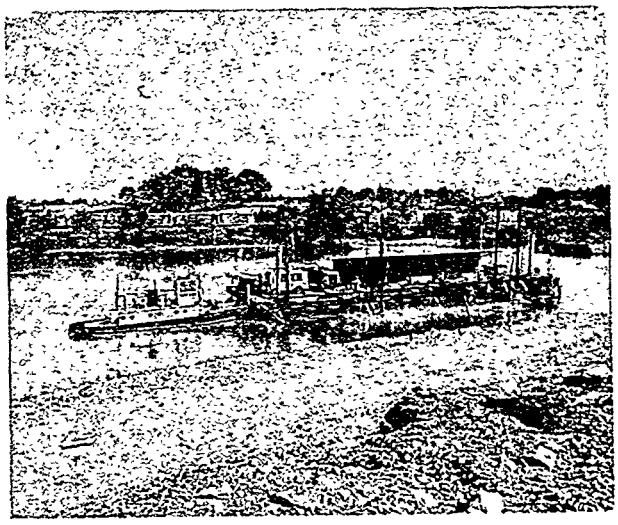

FIGURE 152.—*Job-equipped, 110-ft-long drill barge used for drilling and blasting operations in the navigation channel downstream from Melton Hill Dam (photo from Hiwassee River dredging project).*

Before drilling, a 4-in. pipe casing was driven to rock and washed free of loose material. After drilling, the hole was blown out, loaded with explosives, and stemmed, after which the pipe casing was removed. All holes were drilled 2¾ in. in diameter. In the early drilling operations the hole pattern and depth were altered to obtain broken rock of suitable size for riprap. Hole spacing used at first was 4 ft on centers drilled 3 ft below design depth. Rows of holes were later spaced 5 ft apart and thence to 6 ft on centers, and hole depth was increased to 4 ft below design depth. At this time the underwater explosive used was an insensitive blasting agent requiring initiation by a more sensitive primer. Both were packaged in 1-lb screw-type cans 6 in. long by 2 in. in diameter. The cans were joined in a column with the primer on top. The fuse entered the top of a plastic shield inserted into the primer and secured to the explosives column. The joined cans were suspended on the detonating fuse and lowered into the hole through the 4-in. pipe casing. Holes were loaded to within about 18 in. below the top of the hole and stemmed with sand.

Soon after the dipper dredge started work (January 1963) it was found that the blasting had not been effective in all areas and showed inconsistency in rock breakage regardless of the drill patterns and hole depths used. Additional drilling and blasting under changed patterns and procedures offered little improvement, and the Geologic Branch

was asked to make a study of the operations and recommend changes. Some improvement was realized by reverting to the 4-ft hole spacing, use of reinforced primacord, floating the detonating fuse trunk lines, and reducing the number of holes shot per instant. However, the most noticeable improvement resulted from the use of Pelletol, a waterproof, granular, free-running blasting agent. Pelletol was poured in the annular opening between the 2-in.-diam explosives column and hole wall through a 2½-in. plastic tube lowered into the 4-in. pipe to the top of the hole. Best results were obtained by drilling holes 5 ft on centers, 4 ft below project depth, and using 1 lb of Pelletol for each 2 lb of canned explosives.

The entire blasting operation for the channel downstream from the dam required approximately 640,000 lb of explosives; 1,883,000 lin ft of primacord; and 76,000 primers, points, and shields.

Dredging — The first dredging was done by the 12-in. suction dredge *Josenhans* (fig. 153) starting October 16, 1962. Prior to this time the dredge had been partially dismantled and Watts Bar Reservoir had been lowered so the dredge could pass under the Gallaher Bridge (later replaced) at river mile 14.5. After reassembling the dredge, work started in the Grubb Island area (mile 18.2 to 18.8) and continued for about 6 months. Material consisting of silt, sand, and gravel was deposited on the islands nearby. The dredge was then moved to Jones Island area (mile 19.5 to 20.8) and worked for about 2 months. The suction dredge removed some 83,700 and 24,100 cu yd of material in the Grubb and Jones Island areas, respectively.

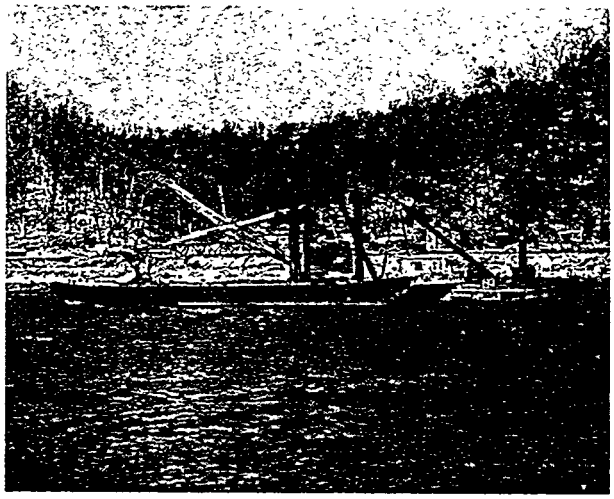

FIGURE 154.—*Nearly 70 percent of the 351,600 cu yd of overburden and rock removed from the navigation channel downstream from the dam was handled by the 3-cu-yd dipper dredge.*

The new Manitowoc 3-cu-yd dipper dredge (fig. 154) arrived November 13, 1962, and after minor

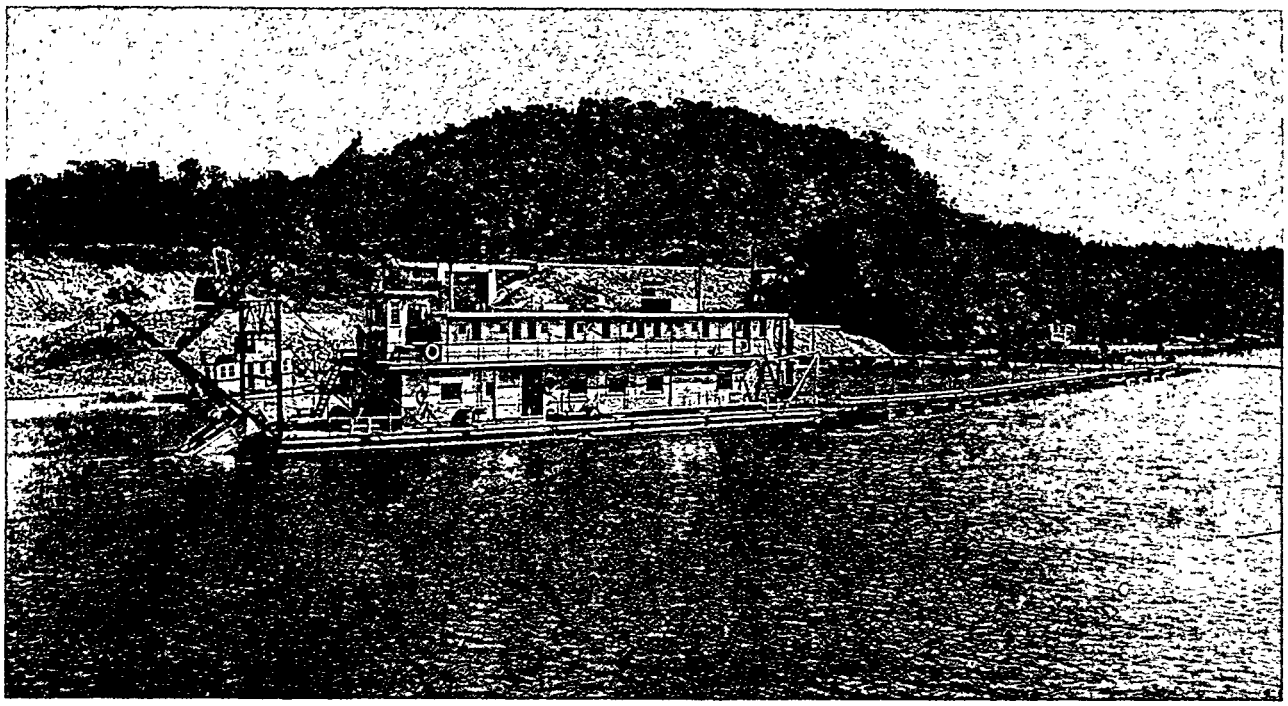

FIGURE 153.—*12-in. suction dredge used for removing silt, sand, and gravel from portions of the navigation channel downstream from the dam (photo from Hiwassee River dredging project).*

alterations was engaged in a 6-week program of training operating personnel. The training period was carried out in the Grubb Island area to clear the channel of loose rocks and other objects which could not be handled by the suction dredge. Spoil was deposited in deep areas in the river and on the riverbanks. After minor test digging in the Jones Island area the dredge was moved to the lock approach area (mile 21.7 to 23.0) where drilling and blasting had been under way for about 4 months. Starting January 21, 1963, dredging was carried out on a 2-shift-per-day basis. The first objective was to provide a safe channel through the area which had been drilled and blasted. The right half of the channel was cleared first and marked with construction buoys. After some trial digging the width of the dredge cut was selected to be 25 ft. Work normally started near mid-channel, progressing laterally toward the bank so the accumulated side roll of broken rock would ultimately fall outside the channel limits. The dredge was so constructed that it could work either right or left and load material on a barge moored to the side opposite the digging. Movement of the dipper dredge was coordinated with the drilling and blasting operations. Approximately 34,600 cu yd of rock removed from the lock approach area was used for riprap on the right bank downstream from the lock. Some dredged material was wasted along the left bank, and some was barged to the upstream end of Jones Island. The dipper dredge is credited with having removed some 81,000 cu yd of rock and 57,500 cu yd of overburden in the lock approach area and 27,600 cu yd of rock and 77,300 cu yd of overburden in the Jones Island area.

The American Revolver steam rig with sweeping attachment and clam bucket (fig. 155) was used primarily for cleanup behind the dipper dredge. This involved removal of large boulders left in the channel

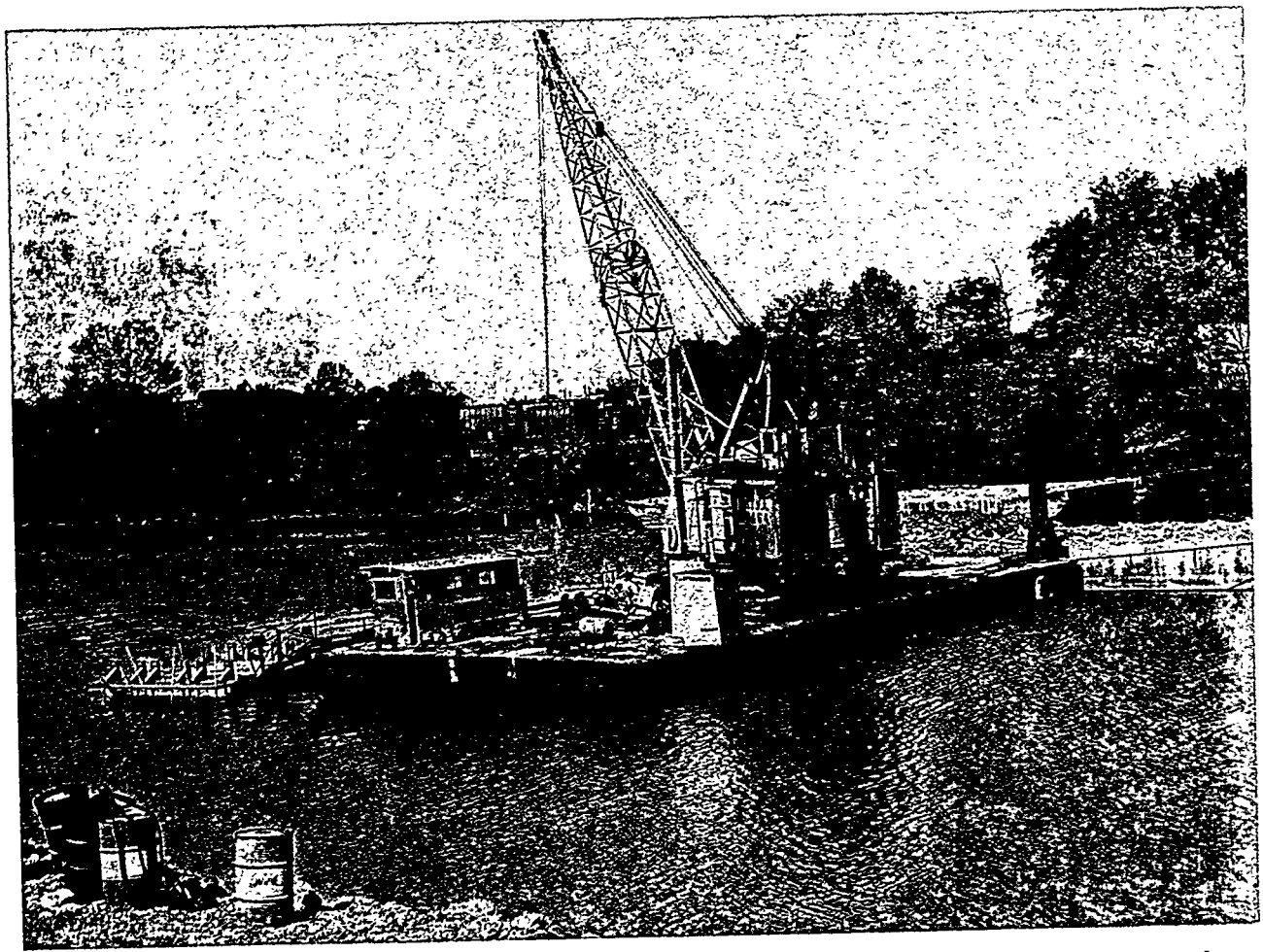

FIGURE 155.—*Cleanup behind the dipper dredge was accomplished with a barge-mounted steam rig and sweeping attachment (shown in left foreground at corner of barge). The sweeping attachment with vertical steel bars set to desired channel depth is moved along the barge by a steam hoist and endless cable arrangement. Tilting of the steel bars indicates a strike, locating the area where additional material is to be removed by the steam rig (photo from Hiwassee River dredging project).*

and along the sides of the channel in the lock approach area. It was used also for general sweeping duty in all areas of work.

Soon after dredging started it was recognized that a need existed for equipment which could be used to grade the channel floor. This need was filled by the fabrication on the job of an underwater dozer (fig. 156). Essentially this consisted of a small barge supporting two conventional bulldozer blades welded end to end to form a single blade 25 ft wide. The blade was pivoted on long arms and was raised or lowered by air hoists supplied by a portable air compressor. It was used effectively throughout the project for clearing the channel floor of material left by dredging equipment.

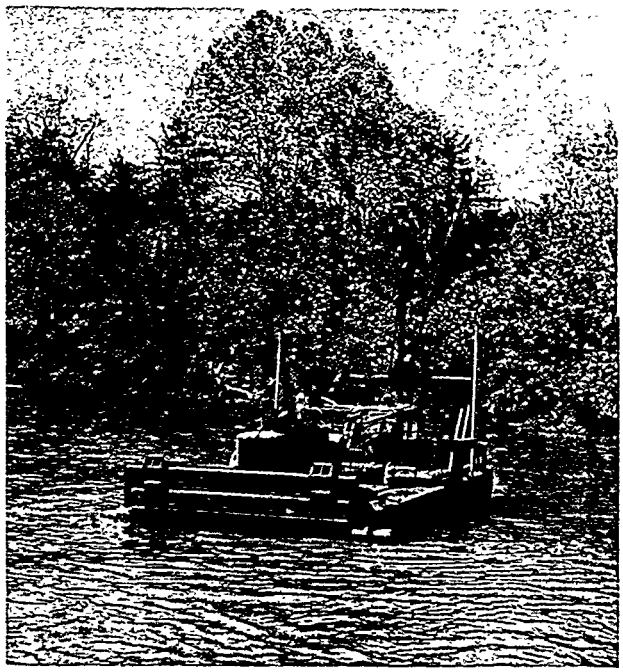

FIGURE 156.—*Underwater bulldozer used to grade channel floor. The 25-ft blade (not visible) pivots on the trunnion at water level at near end. The blade is raised or lowered by the air hoist-boom arrangement at far end. Power is furnished by a towboat lashed to near end (photo from Hiwassee River dredging project).*

Backwater protection

Compared with other TVA reservoirs, the amount of backwater protection work to municipal systems in Melton Hill Reservoir was minor. At Clinton, Tennessee, some slope protection was necessary, and portions of the sewerage and treated water systems had to be relocated to El. 800 or above, resulting in a total expenditure of about $69,417. This involved construction of nine brick manholes and installation of 958 lin ft of 10-in. and 200 lin ft of 18-in. cast iron pipe for the sewerage system and encasing 120 lin ft of the 6-in. water main with concrete.